

Natural Gas as a Fuel for Military Vehicles

By **Bret Strogon** | February 26, 2014

Recent developments in our Nation's oil and natural gas markets have increased America's energy security. For natural gas specifically, this expansion has [reduced net natural gas imports](#), [decreased natural gas prices](#), and created new economic opportunities for many Americans. Natural gas is increasingly being considered by businesses across the Nation as an inexpensive, domestic, clean-burning alternative to petroleum fuels for cars, trucks, buses, ships, and trains. Because these trends may have geopolitical implications and may affect how the U.S. Armed Forces consume energy, the Department of Defense (DoD) is closely monitoring them.



Senior Airman Kristian Magro and Technical Sgt. Jerry Byrdo inspect the engine on a pick-up truck that was operated utilizing a blend of synthetic fuel as part of an alternative fuels test at Selfridge Air National Guard Base, Aug. 10, 2010. The test on the Fischer-Tropsch blend of fuel concluded in July. Selfridge has been the site of a number of test projects of alternative fuels for vehicles and other ground equipment over the last several years. (U.S. Air Force photo by TSgt. David Kujawa)

In fact, DoD already uses natural gas in approximately one thousand domestic non-tactical vehicles, primarily on our bases. Natural gas vehicles are particularly well-suited for bases where trips are short and the refueling infrastructure exists. As one recent example, [Tinker Air Force Base in Oklahoma](#) purchased eight compressed natural gas (CNG) pickup trucks last summer; this initiative has been received as a successful case study, enabling the base to save money on fuel while reducing air pollution emissions. Despite these savings, the high cost of purchasing natural gas vehicles, and costs and limited availability of natural gas refueling infrastructure, have been barriers to widespread adoption at DoD.

That may change, however. Over the next two years, Federal alternative fuel vehicle purchases will increase as agencies meet the requirements of President Obama's [Federal Fleet Performance Memorandum](#), released May 2011. The memo states that all new light duty vehicles leased or purchased by the agencies after December 31, 2015 must be alternative fuel vehicles such as hybrid, electric, CNG, or biofuel vehicles. Already in 2014, the General Services Administration is offering CNG sedans, vans, trucks, and buses. As a result, we may see more natural gas vehicles on our bases in the coming years.

Nonetheless, approximately 75% of the energy DoD uses is considered operational energy, which is defined as "the energy required for training, moving, and sustaining military forces and weapons

platforms for military operations” and “includes energy used by tactical power systems and generators and weapons platforms”. Operational activities are not subject to the same considerations that govern vehicle and fuel choices on our domestic installations. When it comes to carrying out military operations, DoD’s foremost concern is to maintain our superior warfighting capability. For our tactical fleet, there are several important barriers to take into account in considering a switch from traditional liquid fuels to natural gas as a direct fuel.

- **AVAILABILITY:** First, DoD tactical vehicles require a reliable fuel source that can be globally sourced and distributed efficiently to our forces. A significant percentage of DoD fuel purchases occur overseas, and we do not typically export (petroleum) fuels from the continental United States (CONUS) to foreign operations, due to cost and delivery timing considerations.
- **COMPATIBILITY:** Second, natural gas is not a “drop-in” fuel like many of the petroleum alternatives we have been investigating. Most of our current tactical vehicles have been developed around the “one battlefield, one fuel” policy, and many vehicles will remain in operation for decades to come. Accommodating natural gas as a direct fuel would require significant retrofits including new refueling infrastructure and engines, and would introduce, at least during any such transition, two very different fuels on the battlefield.
- **ENERGY DENSITY:** Third, natural gas, either compressed or liquefied, has a significantly lower volumetric energy density than traditional liquid fuels, and, if used, would require significantly larger fuel tanks to maintain vehicle range. Furthermore, the power density of natural gas engines (e.g., horsepower/cubic centimeter) and the fuel economy of vehicles (e.g., gallons/mile, or even BTU/mile), [are often less than that of diesel engines and vehicles](#). In addition, lower fuel density means that the volume of fuel moved around the battlefield via supply convoys could significantly increase. These challenges may be compounded by the difficulty of ensuring battlefield delivery of compressed natural gas or cryogenically cooled liquefied natural gas (e.g., in thick insulated tanks). As we have seen in Iraq and Afghanistan, the logistical tail of supplying energy to our missions already entails significant risks and costs for our troops.
- **SAFETY:** Fourth, tactical platforms must be robust for combat conditions, including undercarriage blasts for vehicles, sea mines for ships, and a variety of munitions for all platforms. As compressed natural gas tanks are under high pressure and natural gas has different flammability properties than traditional liquid fuels, further investigation of burst and fire hazard risks, particularly when under attack, would be required to ensure the safety of our troops. Additionally, refueling activities (think “pit stops”) would likely be both more frequent (given the energy density concerns mentioned above) and of longer duration, and this could potentially slow operations and lengthen moments of vulnerability.
- **ECONOMICS:** Fifth, natural gas may not offer cost savings to the DoD when used abroad. While natural gas prices within the U.S. have become substantially cheaper over the last five years, domestic prices in CONUS are currently approximately 70% lower than European prices and 80% lower than in Japan.

Although the aviation and maritime industries share several of the concerns listed above, niche applications of CNG, or more likely LNG, in these industries could potentially work. Many shipping companies and the U.S. Coast Guard have been exploring potential locations and routes where LNG could serve as a suitable maritime fuel, particularly if its availability and low cost can be assured, and the lower pollution emissions from engines is valued. Some researchers have even explored [potential benefits of using LNG as an aircraft fuel](#).

For now, until the barriers outlined above are addressed, the most likely application of natural gas in DoD tactical vehicles is in the form of natural gas-to-liquid (GTL) drop-in fuels. There are currently five operating GTL plants in the world (in Malaysia, Qatar, and South Africa), one is under construction in Nigeria, [and three have been proposed in the United States](#). In fact, each of the military services has already approved the Fischer–Tropsch (F-T) process for natural gas-derived military jet blends and will soon finish F-T certification efforts for military marine diesel fuels. So long as the final fuel products are cost-competitive with traditional petroleum fuels, certified for use in military equipment, and legally compliant, the military stands ready to purchase them.

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